

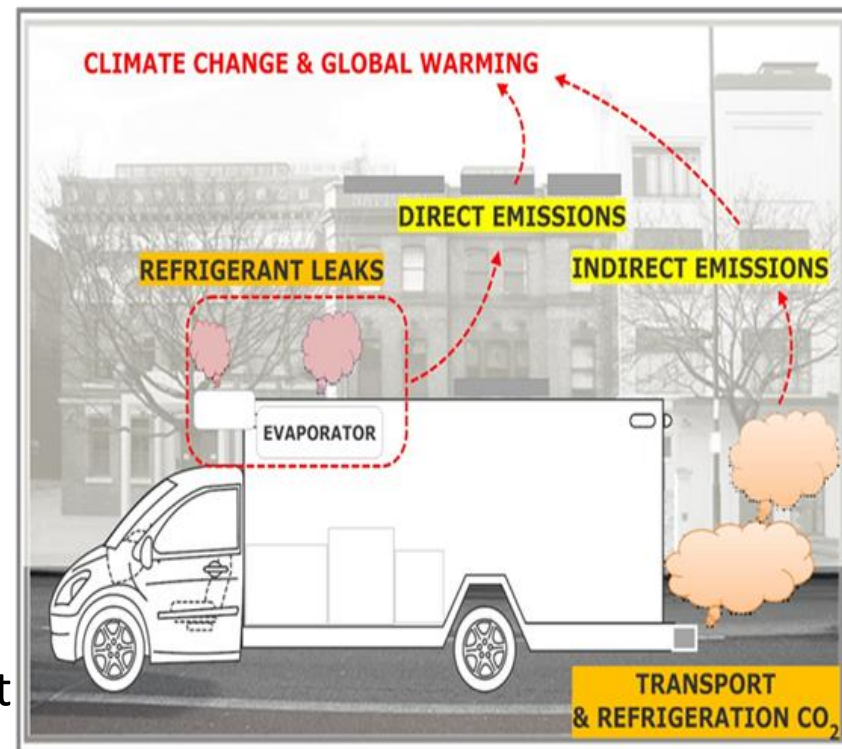
WP2.4 refrigerated road transport (RRT)

Background

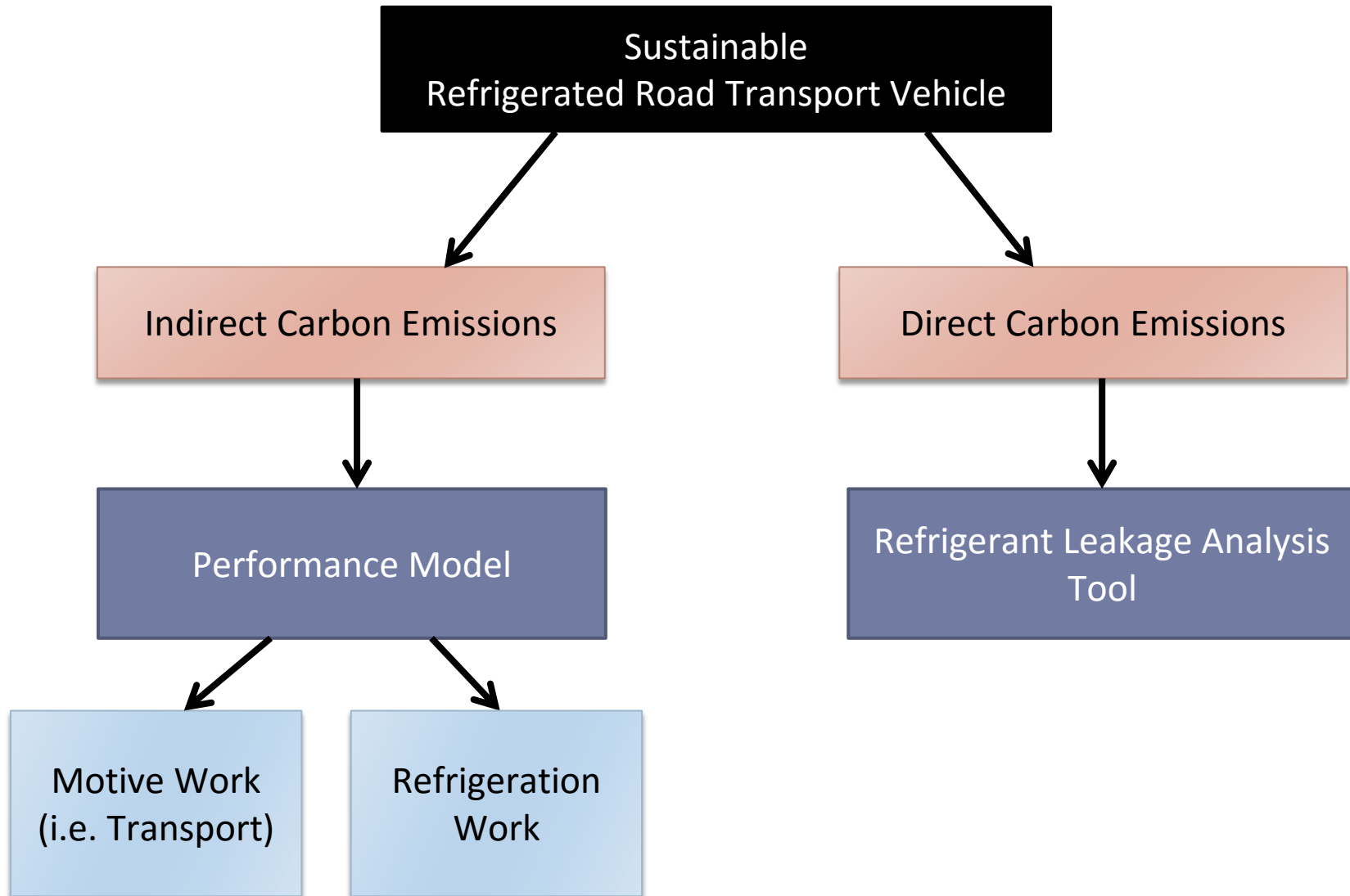
- UK primary food distribution by RRT uses 40% more energy than non-refrigerated vehicles
- Environmental Impact
 - Indirect emissions -
 - Transportation - 2 Mtonnes of indirect CO₂ emissions from the engine alone.
 - Refrigeration - ????
 - Direct emissions -
 - RRT units leak up to 30% of their total refrigerant charge per year
- Cost

Deliverables

- Development of a model to investigate direct indirect emissions
- Optimising system performance

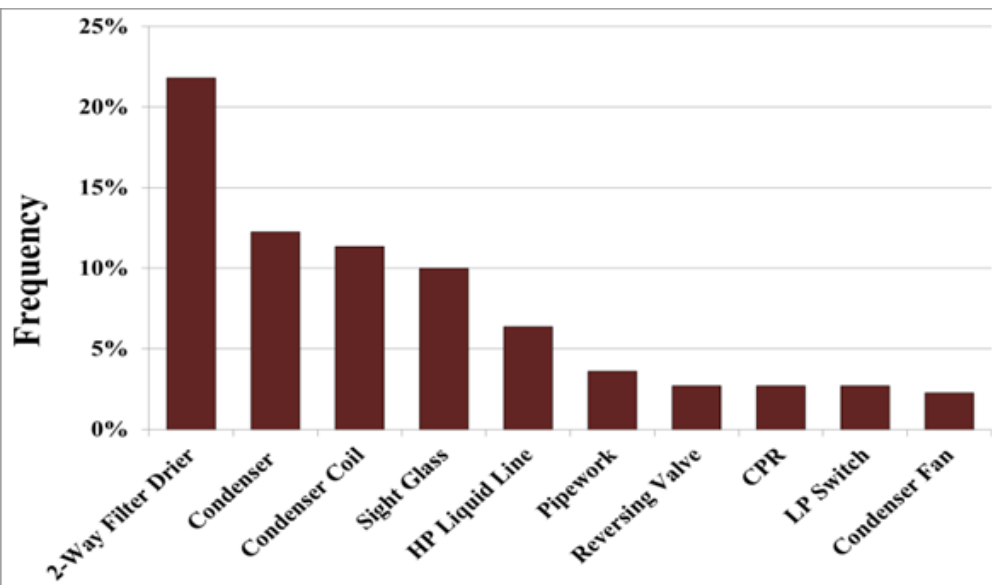


Model Development



Analyse maintenance and leakage records

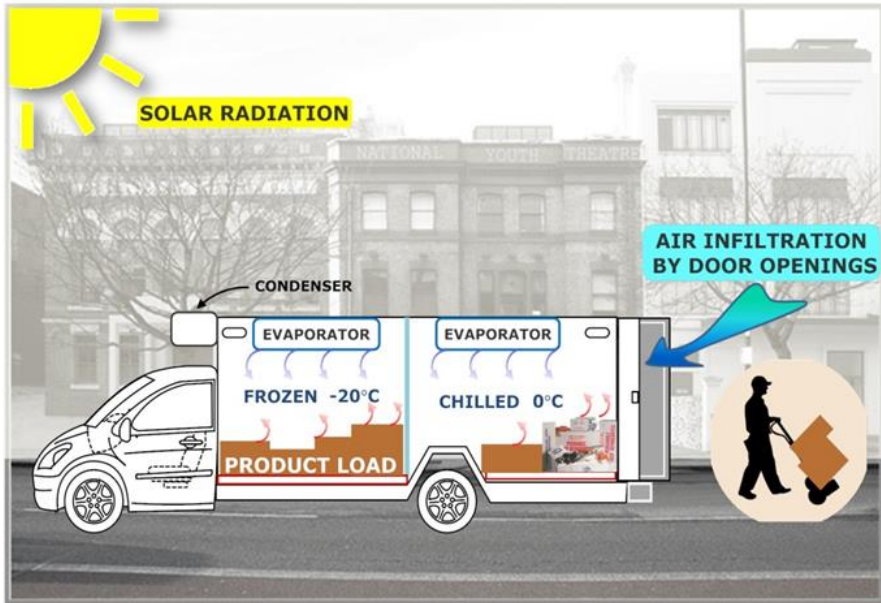
A refrigerant leakage and analysis tool has been developed



- Itemizes and maps each fault to distinct categories and sub-components.
- A sample analysis of RRT service records showed that the bulk of the faults (i.e. 40%) were located in the condenser.

RRT System Performance Model Development

PHASE 1



A model to predict the performance of a UK last-mile RRT systems has been developed.

- Preliminary steady state model.
- **Case study results** show that the refrigeration system account for **4%** and **24%** of the fuel consumed for motive work whereas field data suggested a range of 15-25% (Hutchins, 2007 cited in Tassou *et al.*, 2009).

Future work to include:

- Revising the model assumptions based on actual data measurements.
- Developing PHASE 2 of the model to incorporate transient parameters.

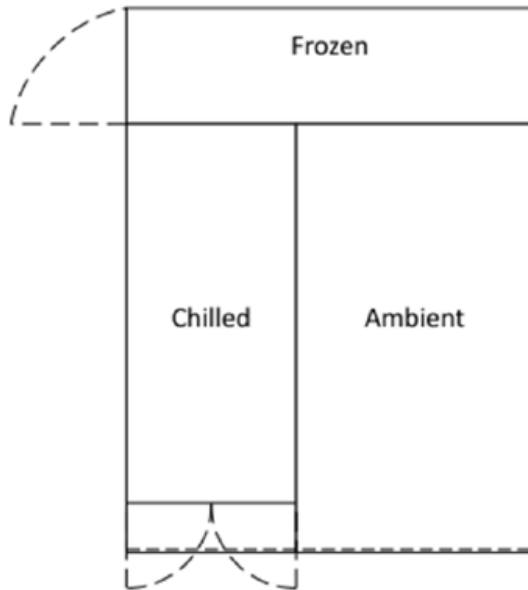
Measure Actual RRT Data

Item No.	RRT Truck Part	Data Collection Instruments
1	Refrigerated/insulated box	Euroscan X2-6 series Temperature Recorder
2	Refrigeration unit	
3	Transport vehicle	FleetBoard Telematics System

Selected instruments comply with vehicle certificate agency automotive type approval for electromagnetic compatibility (VCA-EMC)

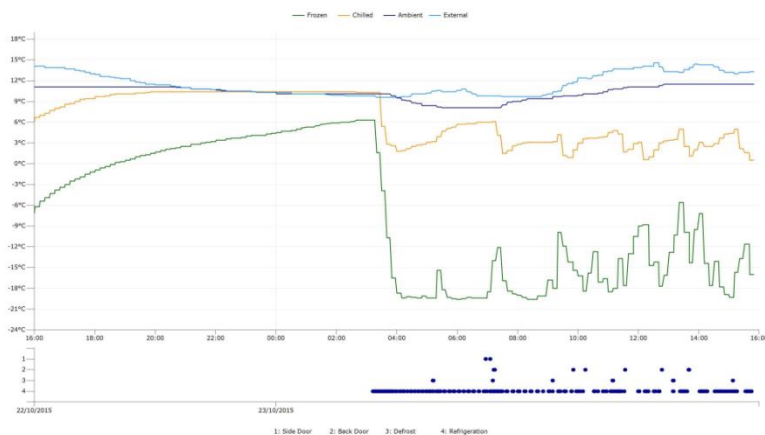


Measure Actual RRT Data



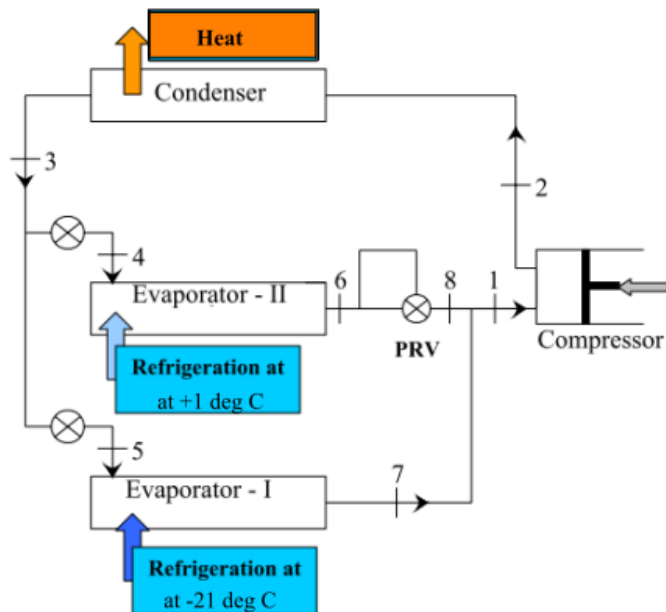
For the refrigerated box

- Temperatures of various critical parameters are monitored with the Euroscan system including:
 - External Ambient
 - Chilled Compartment
 - Frozen Compartment
 - Internal Ambient
- The Euroscan system also uses sensors to monitor and register the events of
 - Fridge on/off cycle
 - Defrost on/off events
 - Rear door opening and closing
 - Side door opening and closing



Vehicle geographical position during delivery journey is also recorded

Measure Actual RRT Data



Multi-evaporator system, single compressor and individual expansion valves

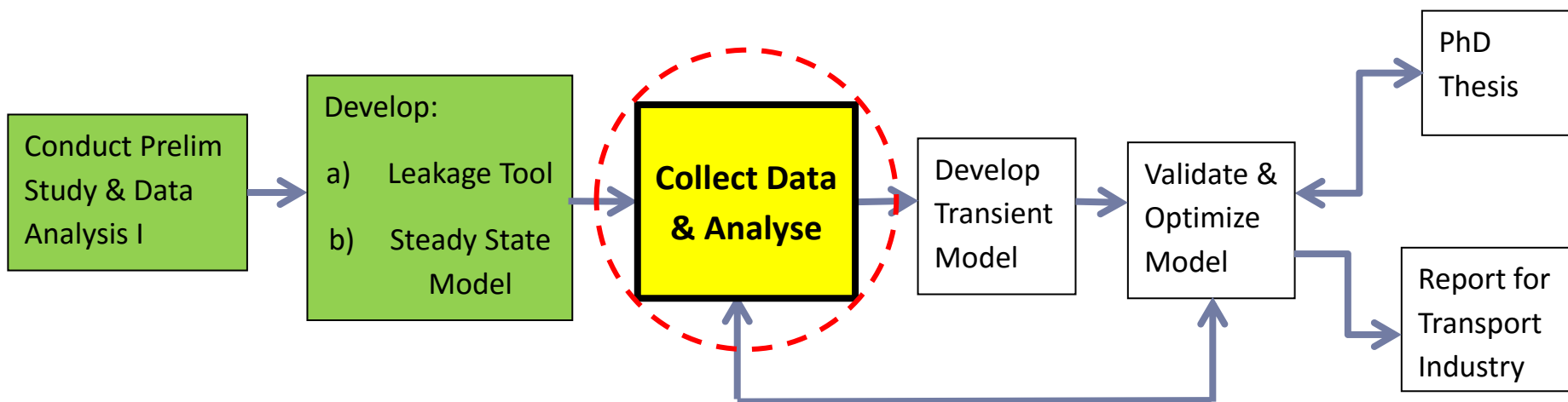
For the refrigeration unit

- Temperatures of various critical parameters are monitored with the Euroscan system
- The corresponding temperatures will then be mapped to a P-h chart

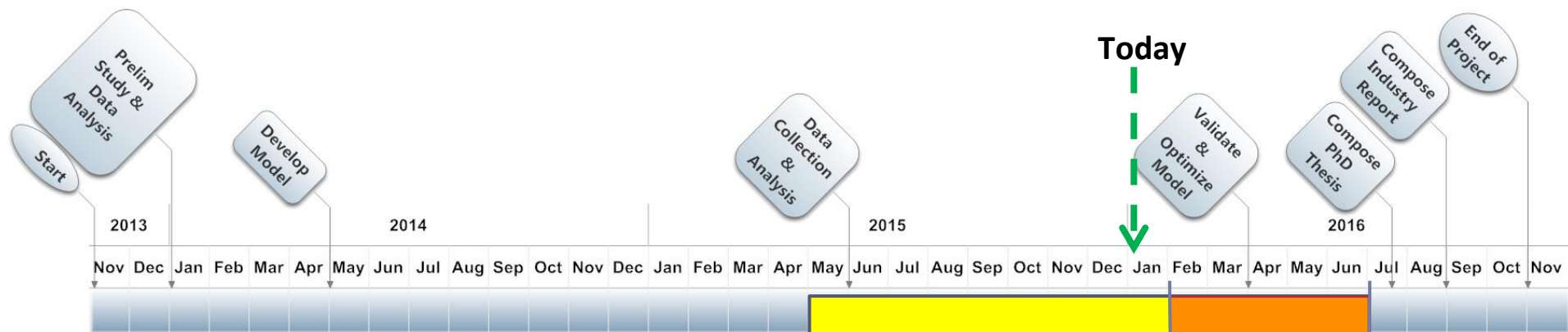
For the transport vehicle

- FleetBoard Telematics Software offers a variety of services for fleet management including:
 - Trip Records – overview of tour data such as moving and rest times
 - Performance analysis e.g. average speed ,fuel consumption

Project Plan flow chart



Project Schedule



Data Collection & Analysis - May 2015 – June 2016

- Instrument refrigerated compartment - Jul 2015
- Instrument transport refrigeration unit- Nov 2015
- **Start data analysis – Jan 2016**

Phase 2 Model Development - Mar 2016 – Jun 2016

WP 2.4 Deliverables

- Developed a steady state model and leakage analysis tool
- Developed a refrigerant leakage analysis tool
- Initiated methodology design to collect data from the RRT truck
- Initiated research survey and collection of operational data on RRT truck



Next immediate steps

- Continue to collect data from the RRT system
- Analyse data on the road performance of home delivery refrigerated vehicles

